The Science Teacher

Storm Clouds Over Grand Tetons — see page 4.

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Developing a Functional Biology Course

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IF MUCH progress is to be made in the developing a sound program of biological sciences, attention must be given to a scientific investigation of objectives for teaching biology. Such a study must be carried on in conjunction with a study of the philosophy of secondary education as a whole. For what are we educating the adolescent youth today and what is, or will be, the contribution of the teaching of the biological sciences to the realization of those goals? The teacher of biology who fails to see the intimate relationships of what she is teaching in the secondary schools to the general outcomes will, in my judgment, never attain the success she might attain. The teacher who fails to note the changed character of the secondary school population, the many varied abilities and interests and aptitudes of high school youth, the varied backgrounds of experience these young people have had, the different environments from which they come, their varied outlooks on life, and the goals for which they are striving, can never, so far as I can see, provide an adequate program of instruction in the biological sciences. Why are these youth in school? For what are they seeking to prepare themselves? For what opportunities are they waiting and what changes have they as citizens in the community to succeed either physically, economically, socialy or morally? These are questions of paramount importance They must be understood and answered. After that the instructional program can be built.

Kinsey reminds us that two very important considerations must be kept in mind. First, we must seek to interest the student in the world in which he lives and, second, we must equip him with a scientific method by means of which he can interpret that world.

STILL OTHERS would tell you that your responsibility as a biological science instructor is to so present your subject matter and direct your instruction that there may be —

1) An improvement of personal and community health.
2) An understanding of all forms of life and growth of plants and animals.
3) An appreciation for, and enjoyment of, all living things.
4) A knowledge that will better provide and insure specific employment.
5) A sufficient motivation for the development of some one or more significant and worthwhile hobbies.

Another group would want you to accept such a recent pronouncement as that of the Educational Policies Planning Commission and so plan your instructional program as to guarantee a greater implementation through science instruction of the four objectives of education in a democracy, namely —

1) self-realization,
2) human relationships,
3) econmic efficiency, and
4) civic responsibility.

ALL OF THESE are fine and to them I would subscribe whole-heartedly. There need be no unamity as to any one of these. They say virtualy the same

thing. Each must select that one which to him offers the greatest opportunity, but select one you must. Having done so, you then proceed to a very critical self-analysis of yourself as a teacher and of your outline of subject-matter or course of study which becomes the vehicle through which, or by means of which, you "ring the changes," so to speak, in the lives of your students.

It does not require any stretch of the imagination or any considerable amount of study to reveal that the biological sciences as taught in all too many schools are falling short of the goals just suggested. Briefly state from my own observations, I have found too many taxonomists, morphologists, botanists, anatomists, zoologists, and physiologists, to name just a few, who are altogether too much dominated by the college traditions and college requirements. They have been teaching subject-matter for its own sake. They have selected textbooks written very largely by college instructors whose objectives are not, and cannot be, those now recognized as desirable in any secondary school situation. They are representative of the taskmaster whose only purpose is to require the memorization of factual materials. Comparatively speaking, it is easy to make the assignment and then examine the student in terms of what he can remember. The material lacks "punch." It is too abstract, too theoretical, too scientific, too non-functional. My advice is to forget the college entrance requirements as stated in terms of subject-matter to be learned. Eliminate the detailed minutiae which have in them little or no value either from the standpoint of student interest or usefulness. Delete scientific terminology which is never used save at the moment. When or how often does the typical high school student after graduation have occasion to use such terms as euthenics or ecology, poleontology or morphology, vacuoles or nucleolus, centrosphere or chromomere? You see the point, don't you?

WHY MUST you require complete dissectioning of either plant or animal life? Why must you insist upon detailed drawings of unicellular or multi-cellular structures? Why must there be a detailed visualizing of all the various stages of cellular division and drawings to scale thereon? As one author whose discussions you have doubtless read had indicated, why must you concern yourself and your pupils with the structural details and functioning of such lower forms of life as the spirogyra, the protococcus, the diatem or paramecium? What difference does it make if a student can or cannot name all the organs of the grasshopper or crayfish or angle worm or tell you how many pairs of nerve ganglia a clam possesses or describe in detail the tarsus, tibia, and femur of the grasshopper's leg? Again, you get the point, don't you? These, to me, are the vestigal remains of an out-worn philosophy of biological science instruction that has no place in our program at the present time. What justification is there for the traditional order or arrangement of topics? Why must one begin with the unicellular form of life and why must one conclude with matters of sex and reproduction?

Why must you know all about the digestive tract of the crayfish or angleworm before that of the homo sapiens? Why not begin with the practical problems of indigestion among human beings? As I heard one biology science teacher of the new order point out, the traditional teacher requires nine times as much of the high school student about the digestive tract of some form of lower animal as the specialist in gastro-intestinal diseases knows after many years of practice. Maybe it is overstating the case but again I think you see the point.

I think I have gone far enough in this thing to reveal to you what I think we ought not to be concerned with as a major consideration. For some few students some of these things might be very well. In that case, let the matter be one

of individual treatment. Let it represent the "might-be-called" extra-curricular assignments.

Let me turn to the positive side of the matter. Consider if you will, what it is that we should put into this program. What are some of the functional values? What are some of the every day needs that should, and can, be satisfied through a properly organized program?

IN NEBRASKA we have come through a very serious period of drouth. Recently this story was told. It is illustrative, at least, of many of the hardships which have been experienced by many Nebraskans.

> "Henry Baumgardner submitted the following to his club paper, THE ANN ARBOR HARPOON, as evidence of his alertness to the national economic situation:
>
> "All of us have no doubt heard a great deal about the terrible drought in our western and southwestern states.
>
> "While passing through Nebraska a few weeks ago I had an opportunity to get some first-hand information on this subject.
>
> "I was talking with an 'oldtimer' at North Platte, and asked him how long it had been since it rained there. He promptly replied:
>
> "'It's been a long, long time, son. In fact, we have our third generation of bullfrogs that don't know how to swim!'"

You may laugh at this story, if you will, but bear in mind the very problem with which this farmer is engaged represents one aspect at least of biological science instruction to which every teacher must give attention. I refer to the matter of conservation of natural resources. By that I mean a consideration of such topics as soil erosion, preservation of wild life, plant selection, rotation of crops, land drainage or its converse, the conserving of water, soil fertility, weed control, and the like. Do these not represent the practical every day problems with which a great portion of our midwest population must now concern itself? Certainly. Where agriculture is the basic industry, we cannot ignore them. Cannot the biological science become functional in respect to these matters and make an important contribution to the solution of the problems? Problems like these are basic and elemental, and if you would be an effective classroom instructor and make a contribution to the teaching of biology, you will have to consider your subject matter in the light of its contribution to the solution of the problems.

A SECOND area in which biology may become truly functional is that in which we deal with family gardens, landscaping, care of shrubberies, the selection and planting of flowers and caring for these through the growing period as well as the period when they lie dormant. Why should not every student's backyard become a laboratory? Why shouldn't the problems of making a lawn serve as the agency through which the content of biological science is more clearly understood, more clearly appreciated, and more truly investigated? How many of us plan our instruction or select problems for study as will take into account the practical contributions which can be made to the matter of improving our lawns and arranging landscape settings? What about the problem of selection of lawn grass for shady areas or open spaces where the sun beats down? How many of us have seen the contribution of biology to problem or restoring lawns, of protecting trees, the proper cultivation of flowers and shrubberies? Also eliminating plant pests, of developing new species of roses, petunias or iris? Does not such knowledge as involved in these represent the functional aspects of the biological sciences? How many students are we sending out of high school who appreciate the importance of such problems as these and who have been stimulated to the point that they will want to become responsible agents in the home, in the beautification of those homes, and in the development of surroundings in which we come to appreciate and enjoy the beauties of nature and seek to preserve them?

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THE SCIENCE TEACHER

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WANTED FOR PUBLICATION

OUR READERS are interested in new subject matter, new ideas, and different methods of teaching. So will you pause one moment and consider what you have found successful and write us a brief note about it? We are interested in articles that describe methods for teaching specific units of subject matter and also new units of subject matter that are different from the usual ones. We are interested in all types of material that will enrich a science course. We are interested in demonstrations, projects, and all types of activities found useful in teaching. This would include science programs for assembly, club programs, and organized activities of a science class.

Often science teachers are too modest about what they do or the value of what they think. We want to encourage you to send in your manuscripts. We shall be very glad to read them and tell you whether they are what we want. If you wish, write us in advance about the material you have in mind.

DALLAS MEETING OF A.A.A.S.

THE ANNUAL meeting this year of the American Association for the Advancement of Science comes again to Dallas, Texas, and affords the people of the middle west and Southwest a real opportunity for inspiration in the science field. Further, the hospitality of the South is well known, particularly of Texas, which should add to the pleasure at this season. The American Science Teachers Association meets there as one of the affiliated groups. See page 27 in this journal for the program.

OUR FRONTISPIECE

FOR THE unusual picture on the cover we are indebted to S. A. Chester of Bloomington High School, Bloomington, Illinois. It shows a sunset with low lying clouds over the impressive peaks of the Grand Teton Mountains in Yellowstone Park.

The Science Teacher and His Journal

HOWARD W. ADAMS

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THE SCIENCE teacher-to-be, during undergraduate years, is primarily concerned with his academic and professional preparation. Getting courses in the biological and physical sciences and developing scholarship is his individual concern and his success is measured by his ability and application. Save for some dissemination of his spirit to his pupils, his practice teaching is largely a matter of his own concern. What other student teachers may be doing is of no vital interest to him.

But when the young science teacher applies for and secures his first teaching position, he becomes dimly conscious of the fact that he has entered a profession whose members are motivated by ideals as high as those found in any other calling. He becomes a member of the teaching staff of a school, a city, a region, a state, and of the nation. School professional pressure will likely sweep him into the local, the state and the national associations. These help him develop a professional consciousness and thus make him a better teacher.

IN HIS chosen field of teaching, be it some of the branches of biological science or of physical science, he begins to feel that his preparation is quite inadequate and he seeks for some agency which will increase his teaching success. The journals of the special sciences, with which he developed a slight acquaintance during undergraduate days, are unavailable to him now or unsuited to his needs.

Here is where a science teacher's journal gives him the much needed help. In such a journal he finds what other teachers in his own field are doing. Here is to be found the clash of ideas held by various workers. The ideas expressed cause him to examine his own and perhaps to modify them. Here are to be found projects suited to the age and ability of his own pupils. The journal, by its carefully edited book reviews, keeps him abreast of the new publications. In the advertising pages is the directory of where to buy his equipment and supplies. The journal displays new methods of demonstration. It offers him an opportunity to contribute to the advancement of his profession by publishing his articles. The magazine will inform him of the professional organizations in his own field of teaching, thus enabling him to affiliate with those that are among the leaders.

MUCH CAN be gained by visiting other schools, provided a time can be found. A day of such professional improvement, costing four or five dollars, would pay for at least two years of subscription to his own science teaching journal, bringing 20 or 24 numbers, which journal would offer several times as many valuable ideas as a day of visiting.

Let the young science teacher support his own science journal by subscribing to it and as his experience and ability increase, let him support it further by his contributions. In this way the teacher helps himself as well as his profession.

Because the science teacher is working in a field of rapidly expanding knowledge, and because this knowledge is constantly coming to be more valuable to the race, the teacher, therefore, must keep step with the advancements. Textbooks can never keep the teacher up-to-date. They tend to make his teaching bookish. But if he is a regular reader of some science journal, he will be made aware of these advances and will find out where he may obtain further information. Moreover, the files of the journal are valuable as a reference work as the years pass. Just as the journal helps the teacher, so it may prove helpful to the alert and inquiring student

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Our Precious Stones Go to Work

H. A. BOLZ

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ALTHOUGH a considerable percentage of nature's precious stones will always enjoy idle existences as gem stones, an ever-increasing number of these aristocrats of the material world are being put to hard work by the scientist and the engineer.

The development of extremely hard metals, alloys and compounds presents the accompanying problem of cutting, polishing and otherwise shaping and finishing these materials. Similarly, the perfection of new, erosive, corrosive and abrasive substances requires that satisfactory conductors and containers be devised to handle them. As the physical requirements of our engineering materials have become more rigorous and exacting in some of these respects, man has had to turn to the rare natural materials in his search for extreme physical properties.

In spite of the high cost of the precious stones, the unique properties that they possess often make them economically useful as engineering materials. Furthermore, the fact that it is now possible to produce some of the rare stones synthetically opens up an entirely new range of economic potentialities for them.

Fig. I. A rough synthetic sapphire, natural size. (Courtesy of The Swiss Jewel Company)

THE EXQUISITE beauty of our rare but commonly recognized gem stones belies the fact that they constitute some of the "toughest" members of the world's family of engineering materials. They possess qualities of hardness, wear resistance and chemical stability that are unexcelled by those of their more rugged-appearing relatives. The comparative hardnesses of the various stones are listed in Table I. The extreme hardness of the precious stones is accompanied by substantial strength, a high degree of wear and erosion resistance and low coefficient of friction. Such an extraordinary combination of properties makes these materials admirably suited for use as cutting edges, abrasives, wearing points, scribes, nozzles, orifices, drawing dies and bearings — bearings, incidentally, that can be used to carry loads without benefit of lubrication. Table II lists typical applications of each of the precious stones. These applications, naturally, are subject to limitations incident to the size in which these stones can be obtained in either their natural or synthetic forms.

Garnet

The garnet, as indicated in Table II, is the least expensive and the least hard of all the rare stones. Its hardness of 6.5 to 7.5 on the Moh scale, however, is greater than that of our hardest metals and is adequate for abrasive work. For this field of application the stones are crushed, ground and graded as to particle size. The resulting powder may be used as such as an abrasive or may be bonded to paper or cloth where a sheet abrasive is desired. All of the various forms of garnet listed in Table I are used as abrasives, although almandite, pyrope, and

rhodolite, being found in comparative abundance in some of our eastern states, are probably the most commonly-used forms in this country. Garnet is not suitable for use in sintered grinding wheels because of its relatively low melting point of 1300 degrees centigrade. Garnets found to possess flawless structure are cut and polished for use as bearings in inexpensive watches, compasses, meters and electrical instruments.

Table I
Forms of Garnet

Name	Composition	Color
Almandite	$Fe_3Al_2(SiO_4)_3$	deep red
Andradite	$Ca_3Fe_2(SiO_4)_3$	yellow, green, brown, black
Pyrope	$Mg_3Al_2(SiO_4)_3$	deep red
Rhodolite	2 parts pyrope to 1 part almandite	
Grossularite	$Ca_3Al_2(SiO_4)_3$	
Spessarite	$Mn_3Al_2(Si0_4)_3$	
Uvarovite	$Ca_3Cr_2(SiO_4)_3$	

Amethyst and Topaz

Although quartz is our second most abundant mineral, some of its colored forms are rather rare. The amethyst and topaz consist of pure quartz or silicon dioxide colored by impurities in the form of manganese and iron oxides. Amethyst is violet or purple while the characteristic color of topaz is yellow. These two sister materials are very much alike in their physical properties with a hardness of about 7 Moh. At present the major applications of amethyst and topaz consist of pivot bearings in small mechanisms and needles for various types of recording machines.

Sapphire and Ruby

It is somewhat disillusioning to realize that the sapphire and ruby, beautiful though they are, are identical in composition to the common, homely abrasive called alundum. These gems, as minerals, are known as corundum. Both alundum and corundum consist of pure aluminum oxide (Al_2O_3) in a sintered or fused form. The former is produced by an artificial process of heating in an electrical furnace, while the latter is a natural mineral.

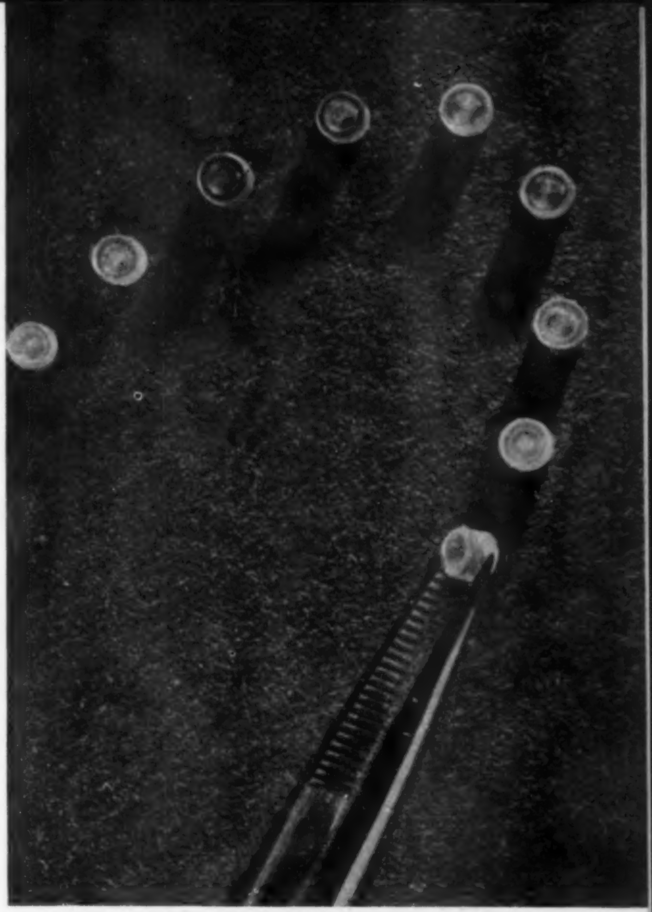

Fig. 2. Sapphire instrument bearing jewels. (Courtesy of General Electric Company)

Ruby and sapphire, of all the precious stones, are second to diamond in hardness (9 Moh). This property, combined with a high degree of strength and shock resistance, makes these materials ideal for pivot bearings in watches, fine instruments and meters (Fig. 2), needles for recording machines, wearing points, etc. Generally, only the imperfectly colored stones are available for such services, since the perfect ones demand higher prices as gem stones. Ruby and sapphire dust, of course, constitutes an ideal abrasive powder.

SAPPHIRE is colored blue by the presence of minute quantities of titanic oxide while the ruby owes its characteristic red hue to traces of chromic oxide present in the otherwise pure aluminum oxide. In jewel bearings for watches the attractive red color of the ruby seems

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Improving Instruction in Chemistry

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University of Illinois — Urbana, Illinois

IN CONSIDERING how to improve instruction in chemistry, perhaps the first thing to do is to decide what is wrong with our present instruction. Every teacher and perhaps a great many of the pupils can find flaws in it, but it may not be amiss, however, for me to mention a few of the things that I think are wrong.

First of all, we set up objectives which sound noble, but which are indefinite, and which have little relation to the courses that we teach. This paper is intended for high school teachers, but this criticism and many of the others which I shall make, can be levelled equally well at teachers of elementary college chemistry. We say that our objectives are to teach students to reason, to think scientifically, and to become better citizens. If I were to pin you down on any one of these points, or if you were to pin me down, we should have trouble in telling just exactly what we do to make our pupils better citizens or how we encourage them to think scientifically. The truth of the matter is that the main objectives of most high school teachers is to prepare their students for college chemistry, or perhaps only to complete the material covered in the text book. I think it is a serious mistake to make the high school chemistry course an abridged college course. Most of those who study chemistry in college expect to use it directly in medicine, engineering or some other profession. This is not true in the high school — only a small proportion of those who graduate from high school will go to college, and a still smaller proportion will continue with the study of science.

MOST COURSES in chemistry, and that means most textbooks, are crowded with material that is out of date, or unimportant for the needs of our students, and some material which is definitely wrong. For example, the lead chamber process, Deacon's process for making chlorine, Brin's process for oxygen, and the arc process for nitric acid are all disappearing from the industrial scene, but not from the text books. We may argue that these processes furnish excellent examples of chemical principles, but this is a weak argument, for the same principles can be illustrated by many current industrial operations. The elemenetary chemistry course is overcrowded without including outmoded technical processes.

The teaching of theory suffers from the same defect. Our theories of acidity and basicity, of ionization, and of valence have changed entirely in the last decade or so, but many teachers still teach the old theories, and then pile on top of them the newer and more satisfactory ones. Most of the students who come to our university with a unit credit in high school chemistry have been taught the Arrhenius theory of ionization, and know no other. There is no valid reason for this. The newer theories, once the teacher studies them out, are easier to understand, easier to teach, and more satisfactory in explaining the phenomena involved.

CERTAIN other topics should be eliminated from the high school course as being quite unessential to a clear understanding of chemistry. As examples, the Law of Multiple Proportions and the balancing of complicated oxidation-reduction equations might be cited. A student who plans to use chemistry in his daily work should certainly know the principles used in balancing equations, but I see no reason why anyone else should be drilled on such reactions as that between potassium permanganate and ferrous sulfate in the presence of sulfuric acid. There are too many other more important things to teach.

The weakest part of our chemistry instruction is found in the laboratory. Most of the students go through the experiments in purely routine manner, slaves to the directions which appear in the laboratory manual. This is difficult to avoid, I suppose, because of the rigidity in school programs. The experiments assigned must be short enough to be completed in one laboratory period, they must use simple and inexpensive apparatus, and they must be of such nature that students will be led to think and arrive at some conclusions based on facts gained in the laboratory.

WE ASSIGN our students far too many experiments. If they are to do all that are assigned, they cannot do justice to any one of them. Certainly this is not the way to teach careful observation or scientific reasoning. I believe that the student should be given freedom to continue on an experiment as long as he is learning from it; even if he does only a few experiments during the term. I look back with lasting satisfaction to an incident in my early teaching career, and wish that more such examples had brightened my way. The class was studying the reaction between dilute nitric acid and copper. This reaction proceeds very slowly at first, but is catalyzed by the nitric oxide formed. One of the students in the class raised the question "How do you know that the acceleration of the reaction is due to catalysis? Maybe it proceeds slowly at first because the copper turnings are corroded." He was asked to devise a test for this, which he did easily. He used bright copper, but found the reaction proceeded very slowly for the first few seconds after the nitric acid was added. Then he raised another question, "How do we know that it is the nitric oxide which is the catalyst — copper nitrate is also formed in the reaction?" This, too, was tested easily. A crystal of copper nitrate dissolved in the nitric acid produced no apparent effect. This student learned more about the scientific method, and got more lasting satisfaction from this brief excursion into chemical research than he could possibly have gained by simply following directions in a hundred experiments.

But I do not want to spend all of my time pointing out faults in our teaching. I should like to mention a few things that I think should be given more attention. First of all, I would emphasize the social, economic, and political implications of living in a chemical age. I do not mean that our high schools should specialize in "Consumer Chemistry," or that the teacher should devote a great deal of time to pointing out that our cars, radios, jewelry, and drugs are possible because of chemical research. These things come in naturally, and make a sufficient impression without emphasis. I think that it is worth while to point out, however, that the economic and social changes brought about by advances in chemical knowledge are far reaching and many sided. Sometimes they bring hardship, temporarily at least, by wiping out old, established industries. Thus, while the processes of nitrogen fixation have lowered the cost of fertilizer, and have thus brought increased prosperity to farmers, they have all but destroyed the principal industry of Chile. In the same way, the development of synthetic rubbers, of rayon and nylon, has stimulated certain industries and destroyed others. For the most part, of course, industries here in Amerca have been built up at the cost of those in foreign lands. This is not always the case, however. For example, China has profited enormously from exports which she could not have made had it not been for chemical research in other parts of the world — exports of tungsten, antimony, camphor, and many other substances.

ANOTHER example of the sort of thing that I mean is governmental regulation of the price of native silver. By setting a ficticiously high price on silver, we ostensibly hope to aid the ailing silver industry. This entails, however, encouraging the mining of lead and cop-

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Science for Society

EDITED BY JOSEPH SINGERMAN

● A department in which science is presented in its close relationship to the individual and in which guidance is given in causing the individual to recognize the methods of science and its vast social implications.

The Scientist and the Consumer*

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WHAT scientists can do for consumer protection is a large subject for a twenty minute paper. I suggest it as the subject of a one-year course in every college of science and engineering. Why not? Science covers every hope man has that some day he is going to use his creative powers to the full to provide a good living for every human being, and consumer protection covers the desire of every one of us to enjoy that kind of living. It would be well worth a year of the science student's time to consider why, with all these productive powers on the one hand and all these desires on the other, we somehow continue to deny the one and deprive the other.

WHAT do consumers want to be protected from, and what can the scientist do to help them? First and foremost, consumers want abundance. They want maximum output all the time of the largest possible number of different kinds of goods, and they want them produced at minimum cost so they can buy them. Therefore, they want to be protected against every kind of monopoly, combination, trade agreement, law, program or social device which intereferes with the production of all that is possible, at least possible cost. Next, (and this is all there is to it, it's really quite simple) they want to be able to choose from this abundant supply the goods that best serve their individual needs and pocketbooks. Therefore, they want to be protected from frauds, misrepresentations, half-truths, chicanery, and the prevailing practice of withholding from consumers the facts they need to know.

Sum it up this way: The consumer wants to be protected from having to spend his money blindfolded for an unnecessarily limited supply of goods which sell, consequently, at prices which often he cannot afford to pay.

How can the scientist help him? Only so far — I think we should agree at the outset — as he is permitted to do. To the satisfaction of consumer wants the scientist has already contributed greatly No one in his right mind would attempt to belittle or deny the tremendous increase in productivity that has marked this country's progress in the last 70 years. However, if he were wise he would not assert that we have done all that can be done, or all that must be done if we intend to hold this country together so that it may continue to make progress. We cherish liberty and we love the flag, but the world has brought us to a pass where we have either got to fish or cut bait; we shall have to give free rein to our productive powers and unlimited scope to the creative powers of our scientists, or we shall not continue to enjoy the liberties we cherish.

THE SCIENTIST is instrumental. He brings to industry his discoveries, his precision, his techniques for the control of materials and natural forces. Whether his contributions are used or not is not up to him. Nor can he require that, if used, they be used for social rather than selfish or destructive ends. He deserves credit for a great part of what we have accomplished in larger output of better

* Address delivered before the American Association of Scientific Workers, Philadelphia, Pa., Dec. 28, 1940.

goods at less cost. He is not to be held to account for our failure to use his knowledge to provide for men everywhere such an abundance of human well-being as would banish economic slavery and make war impracticable. War, when it comes, uses science for abominable purposes; but war comes because we have not allowed science to serve man as it is able to serve him. War comes when for too long we have kept science and the consumer too far apart.

In the field of physical production, including the physical moving and storing of goods on their way to ultimate users, science has worked miracles. That these miracles have been put to use is, however, only partly to the credit of the scientist. The other part goes to the risk-taker, the businessman, who undertakes to market the new products which the scientist has created, or who ventures to face the hazards of mass production, thus giving the scientist and the engineer a new opportunity to show what they can do. By the same token the scientist can rightly deny any share of the discredit when his knowledge and his discoveries are purchased by the businessman and turned against the consumer. Holding useful inventions or new materials or methods out of use betrays science rather than discredits it. So, too, when patent rights are employed as an instrument of coercion in restraint of trade.

IN THE arts of trading, which govern the purchase and sale of goods, the case for the scientist is the same, only here there is less that science can contribute. The businessman gets along better at this trading game without the help of science, unless, as some say, the studies of economics, marketing, advertising, merchandising and management are sciences. I don't believe they are, but whether or no, the point is that in the physical sciences — where the issue is man's control over things and natural forces — great contributions to consumer welfare are possible and have already been made, whereas in the so-called social sciences — where the problem is man's ability to control himself and others like him — the going is not so easy. Science has contributed much more to the arts of production than to the trading processes of distribution.

As a result we find that distribution is today a very imperfect instrument compared to production, and is the source of many very grievous consumer problems. Distribution occupies a large place in our economic system. The Twentieth Century Fund makes the rough estimate that in the year 1929 distribution costs, including the physical moving, storing and handling of goods, took 39 billion of the 66 billion dollars which consumers paid for goods in that year. That's 60 cents, on the average, out of every consumer dollar expended. About 20 of the 60 cents, they tell us, went to retailers, 25 to intermediary handlers and for transportation, and the remaining 15 of the 60 cents went to cover manufacturers' distribution costs, advertising, installment charges and so on.

OF COURSE, a great deal of this distribution is just as productive in an economic sense as is the physical process of putting the goods together. But when you see that it costs one and one-half times as much to distribute goods as to produce them, you can see why the consumer wants to make certain that he is not paying too much for what he buys and is not getting something he doesn't want. As distribution practices stand today he has a tough time of it on both scores. Let me illustrate.

For one thing, he is everlastingly bedeviled to buy a better grade of product than he can afford. Urging customers to buy top quality products at premium prices is considered a virtue among merchandisers, but for most consumers with limited pocketbooks, it is a gross disservice. Milk is an example. It is, or should be, a basic commodity. It should be available to every home in adequate quantities. Yet the milk business persists in trying to make a luxury article of it.

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Science Clubs at Work

EDITED BY KARL F. OERLEIN
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A department devoted to the recognition of the splendid work being done by the science club members and their sponsors in the various State Junior Academies of Science. Material for this department, such as student made projects; demonstrations and posters; outstanding club programs; state and regional meeting announcements; should be sent to Dr. Oerlein.

Kentucky Junior Academy of Science

INTRODUCTION

For the material in this issue we are indebted to Dr. Anna A. Schnieb, counselor for the Kentucky Junior Academy of Science and editor of the Junior Science Bulletin which serves the clubs of that state. The student articles presented here are mostly taken from the Bulletin and have been selected to give interested workers in other states some idea of the methods used and the accomplishments in Kentucky.—Editor.

THE MEMBERS of the Kentucky Junior Academy of Science appreciate the opportunity of being represented in the December issue of The Science Teacher. They consider this an honor and they hope that the readers will find their articles interesting and instructive.

Mounting of butterflies presented before science teachers by Atom Club, Paint Lick High School.

The Kentucky Junior Academy of Science is sponsored by the Kentucky Academy of Science which means that the Senior Academy supplies speakers gratis for the affiliated clubs and that it gives some financial aid to the Junior Academy. It has grown steadily, as the following indicates:

1932: Committee of three members of Senior Academy made a report on the feasibility of a Junior Academy.

1933: Forty-six high school students attended the annual meeting of the Senior Academy.

1934: First organized meeting was held, representing 9 clubs with 310 members.

1940: There were 33 clubs with 783 members.

1941: There are 41 clubs with 943 members.

The Kentucky Junior Academy of Science has two objectives:

First, to help the high school science teacher do effective teaching.

Second, to make it possible for the high school pupils to acquire a genuine interest in science by obtaining first-hand information; and to learn to think clearly and to interpret the less complicated implications of science in their respective communities.

THE DIFFICULTY in extending the work of the Junior Academy has been to convince the science teachers that the science club is an excellent means of recognizing individual interests; that it does not mean additional work, but less work and more effective teaching in that the pupils are really interested and are learning through their own activities

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Chemical determination of metal in tin foil demonstrated to teachers by Einstein Science Club, Kirksville, Kentucky.

Metals in Foils

WANDA KING

Kirksville, Kentucky — High School Student — Kirksville High School

MANY ARTICLES used daily, such as candy bars, chewing gum, tobacco, cheese, and tea are wrapped in thin metal sheets, commonly called "tin foil." Metal foil, when properly wrapped around something, keeps out the moisture. Since the very thinnest wall of water is impervious to water, the foil is often glued to paper or cloth to give it strength.

In nine cases out of ten, foils most commonly used today are not tin. At one time, however, tin was the metal of which most foils were made. Gold, lead, and tin were the only malleable metals.

Ninety-five per cent of all the metal foil of today is aluminum. The use of aluminum as a foil has been most satisfactory, because it protects well, stays bright, and can be rolled thinner than fine tissue paper. It is the foil commonly used for most of our candy, chewing gum, and tobacco.

TIN FOIL, made of real tin, is still used as a wrapper for cheese. Aluminum can not be used for this purpose. There are discolorations that result from the reaction of certain salts and acids in cheese with aluminum. Lead foil is still used to line the inside of certain packages of tea.

Twenty samples of metals from candy, chewing gum and cigarettes were tested in our laboratory to determine the metal of which they were composed.

Following is an easy procedure for the testing of foils for metals: one square inch of the sample is dissolved in strong nitric acid. A part of the clear solution is poured off, diluted with water, and ammonium sulphide is added drop by drop. A brown coloration or precipitate will indicate tin; a black precipitate will indicate lead.

The test for aluminum is made by pouring off another portion of the clear solution. Ammonium hydroxide is added. A white jelly indicates aluminum.

Making electric motors and wiring a building demonstrated to teachers by members of Escohi Vesalius Science Club, Irvine, Kentucky.

Superstitious Medical Practices

LORAYNE POWELL

Pasteur Science Club

Red House High School — Red House, Kentucky

This article was given at the annual meeting of the Kentucky Junior Academy of Science and was judged the best discussion in Class B.

THE PRACTICE of medicine offers a favorable field for tracing the course of superstitition. The early and widespread notion that disease is caused by the invasion of a foreign spirit comes from the days when priest and physician were one. By weird ceremonies, the shaman or priestly medicine man, attempts to drive, or suck, or frighten the spirit out of the afflicted body. The drums and the rattle, as well as a bag of herbs or magic odds and ends are his insignia. A dream is regarded as a real experience in which the soul of a sleeper takes an excursion to another world and brings back reports. Hence the practice of never awakening a sleeper, lest his soul fail to find its way back to the body.

I HAVE made an investigation of the superstitious practices used in my community for the purpose of preventing and curing certain diseases. For instance, when one is exposed to chicken pox, it is believed that he should lie in the doorway and have some one drive a chicken over his body for the prevention of the disease. To prevent a baby having the croup, stick its big toe in the first snow that falls. The wearing of onions around one's neck will ward off numerous diseases. Always spit over the left shoulder when you see a fever or wooly worm to avoid typhoid fever. Nutmeg worn around the neck is effective in the prevention of boils. A piece of lead worn around the neck prevents the nose from bleeding. To stop the nose from bleeding, put a clot of blood on the blade of a knife and stick the blade into the ground. Another cure of nose bleeding is the pouring of cold water on the back of the neck. The pressing on a cork stopper upon each temple will also relieve nose bleeding. A buckeye carried in the pocket will cure rheumatism. Magic rings worn on the finger are also used as a treatment of rheumatism. A snail shell carried in the pocket will cure the headache.

THERE ARE a number of superstitious treatments for sties, such as the rubbing of a gold ring upon a Brussels carpet and touching the eye with it; or you may go to the forks of the road and say,

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Impatienx Sultani Sugar

RESEARCH COMMITTEE*
Darwin Science Club
Waco High School Waco, Kentucky

This article was given at the annual meeting as a discussion in Class B and received Excellent rating.

OUR BIOLOGY CLASS at Waco was making a study of the products and by-products of the native trees of our American forests. One of the members of the class gave an oral report on Sugar from Wood. During the report the student said that "It is estimated that an acre of forest land can be made to yield as much sugar as an acre of ground planted to sugar beets." This statement, from the World Book Encyclopedia, Vol. 15, page 6908, was accepted as a challenge by the other members of the class. In an attempt to find all available sources of sugar oral reports were given daily for two weeks. Round table discussions followed each report. Someone found that hydrochloric acid was added to the glucose in wood pulp to produce sugar. Since we had no wood pulp or trees in the room but had several sultani plants, one of the students suggested that we try watering some of these plants regularly with a dilute solution of hydrochloric acid. We decided to try it and for six weeks the class eagerly and carefully watched the fragile plants daily.

I. Our problem — To see just what effect a very dilute solution of hydrochloric acid would have upon sultani plants.

II. Materials — Six sultani plants, 1 quart beaker, 1 pint beaker, 2 five gallon glass containers, fertile limestone loam, hydrochloric acid, six earthenware jars, and rain water caught in porcelain lined jars because we didn't have distilling apparatus suitable to distill large quantities of water.

III. Procedure —

1. We chose three vigorously growing sultani plants for the purpose of adding the solution.

a. A sultani twenty-four inches high with 367 leaves, growing in a two gallon earthenware jar.

b. A sultani twenty inches high with 317 leaves growing in a two gallon earthenware jar.

c. A ten inch sultani with 15 leaves growing in a three quart size earthenware jar.

2. We chose three vigorously growing sultani plants as a control group.

a. A sultani twenty-four inches high with 386 leaves growing in a two-gallon earthenware jar.

b. A sultani twenty inches high with 297 leaves growing in a two gallon earthenware jar.

c. A ten inch sultani with 19 leaves growing in a three-quart size earthenware jar.

3. All six plants were placed near windows where afternoon sun could shine upon them.

4. We filled within an inch of the top the two five-gallon glass containers with rain water.

5. We poured into one container .1 ml. of hydrochloric acid and stirred thoroughly. To the other five-gallon jar nothing was added.

6. Once each morning 375 ml. of the solution was used to water plants (a) and (b), 125 ml. of the solution was used on plant (c).

7. 375 ml. of the rainwater without hydrochloric acid was given to plants (a′) and (b′), 125 ml. was used to water plant (c′).

8. The temperature of the room was kept at 65 degrees F.

IV. Findings —

a. Plants to which solution had been added:

1. At the end of the first week there was no visible difference in the appearance of the plants.

2. At the end of the second week the same.

3. Near the end of the third week the hydrathodes under the leaves of the plants to which the solution had been applied began to swell.

4. By the end of the fourth week tiny droplets of liquid were suspended by a hair-like formation about one-sixteenth of an inch from each hydrathode.

5. The fifth week these droplets began to crystalize and gradually grew larger. The leaves of this group of plants began to show minute white spots on the top side.

6. By the end of the sixth week these granules were three times as large as those found in ordinary granulated cane sugar. They were very hard and white.

7. These crystals dissolved readily in water but were insoluble in alcohol.

8. Upon subjecting the crystals to the Fehling test the solution changed from a bright blue color to a rust brown indicating the presence of a great amount of disaccharide sugar.

9. The sugar tasted sweeter than glucose or grape sugar but not so sweet as sucrose.

b. Plants which were watered by rain water without hydrochloric acid.

1. From the beginning of the experiment these plants grew vigorously just as those to which we added the hydrochloric acid solution. This group continued to have a rich green color without white spots.

2. The hydrathodes enlarged slightly but there was no visible exudation.

3. This group of plants showed no evidence of sugar crystals. All six of the plants under observation seemed to grow with equal vigor and all six bloomed profusely.

V. Conclusion —

1. That by treating impatienx sultani with a very dilute solution of hydrochloric acid disaccharide sugar crystals are formed.

2. That we must continue to search diligently botanical history to find whether another person or group of persons have recorded any evidence of the exudation of impatienx sultani crystalizing into disaccharide sugar.

* Research Committee: Bernadine Robinson, Mary E. Cotton, Hermon Lamb, Anna M. Hisle, Burt Renge
Darwin Science Club, Waco H.S., Waco, Ky.

MEDICAL PRACTICES

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"Sty, sty, leave my eye, Catch the next one who passes by," and the sty will leave. Rub the affected eye with the end of a cat's tail is another "cure" for the sty.

During my study, I have discovered four superstitious ways of getting rid of warts. Which are: (1) Hide, secretly, a rusty needle under a rock; (2) Take the skin of the gizzard of a chicken, let it dry and rub it on the wart several times a day and the wart will leave; (3) Pick a wart until it bleeds, put a drop of blood and the heart of a grain of corn and feed the corn to a chicken and the wart will disappear, and (4) Hide a dish rag secretly under a rock and the warts will disappear. Drink nine swallows of water without breathing and the hiccoughs will be cured. Another "cure" for the hiccoughs is to say, "Hiccough, straight up, three drops in a cup" and drink three drops of water and the hiccoughs will stop. Crawling under a mule has been recommended to cure the whooping cough.

INTERESTING as these medical superstitions may be, they are nevertheless ridiculous and in many cases are most harmful in that they might directly cause infections which often result in dangerous conditions or even death. It would be astonishing to know just how many fatalities are due each year to superstitious treatment of diseases which could be cured by intelligent medical aid. The battle between enlightenment of science

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Biology in Our Town

MARY CREAGER

Vienna Township High School Vienna, Illinois

IT IS NOT enough to teach biology to the youth of today with their constantly repeated "Why?", but biology, like every other subject, must be justified. Like many teachers, I have paused to consider the "why" of my students as applied to biology. "Why study biology?"

In answering this question of why biology is practical and of major importance in everyday life, I find a series of field trips and visits to different parts of our small town helpful. These trips answer the question more clearly and dynamically than any recital of facts or quotations from persons or books.

The trips include visits to the Forestry Station, Nursery, Trichoma Clinic, the Health Station, Water Plant, Hatchery, and Farm Bureau.

In every case we have found the persons in charge more than willing to cooperate, taking their time to lecture to the students and appreciative of the students' attenion and questions. The students cooperate by furnishing cars which save time on the longer trips. Each trip can be made in one class period (60 minutes) and usually requires a period or more for the general discussion and the written work required in recording the information in notebooks. The best reports receive special recognition.

The trip to the Forestry Station is made in connection with the unit on conservation. Here the students learn how fire alarms are turned in, how a fire is located, what squad is called out in each case, what standard fire fighting equipment is and how it is used. They are given literature on fire prevention, the evils of fires and a map of the Shawnee District. This trip is one that always thrills the students.

The nursery is located just north of the school. This trip is made in the spring while the class is studying the unit on reproduction, which includes, of course, budding and grafting. The students are shown how budding and grafting are done, and they have an opportunity to see 50,000 budded trees putting out leaves for the first time. Of interest are the numerous species of plants raised at the nursery.

ALL WHO KNOW of the magnificent work done by the five trichoma clinics of southern Illinois feel proud, but I find that usually only about twenty per cent of my class even know that there is a trichoma clinic in Vienna until after our trip. Students come away with a new reverence for science and the miraculous curative qualities of sulfanilimide—grateful in the knowledge that they will never have to be blinded by the dreaded disease.

The Health Office is an excellent example of preventative medicine. It offers to the student a better understanding of the value of their work to the community and develops a feeling of cooperation from the knowledge and attitudes gained.

The water plant will hold the attention of students, even of those who are not exactly "scientifically" minded, while the hatchery is a good place for observing both the practical and experimental side of biology. Experiments are being tried that are quite interesting to the students.

After each trip I have come to expect such remarks as, "Well, I'm glad we went to the clinic. I didn't know about trichoma before."

"I'd like to be a forest ranger. I think that would be a good job."

"My folks heard me read all of my report. They were very interested."

These remarks lead me to feel that I have, in a measure, answered their question, "Why study biology?"

Evaluation of Two Methods in Biology

CHARLES C. CLARK

Edgar Public Schools

Edgar, Nebraska

FOR MANY decades teachers of science have been concerned with the mere giving of factual information, assuming, of course, that it would be stored in the mind of the student and used at some future, remote time. This pouring-in process naturally places emphasis on rote memory learning. But such learning and teaching do not conform to the purposes of science education as it is conceived today; these methods fail to recognize that most facts are retained for only a short time.

"Whole" learning is now recognized as an economical way of learning. The "whole" in science refers to the principle, generalization, or the problem. Therefore, the unit of work should be so organized that all the learning situations will contribute to an understanding of the principle or generalization. The exercises which comprise the unit must be carefully selected and organized to give the student complete insight into the unit. Learning, then, is an organizational process in which the student gains an understanding of the essential ideas and sees them as a part of a larger meaning called a principle or generalization.

THUS, WE find two schools of thought when it comes to the teaching procedure in science classes. We have the stereotyped recitation method of teaching with emphasis upon narrow fact type questions. The instructor does most of the preparation, he has his subject matter mastered and grouped so as to facilitate ease of presentation. He presents it in a lecture sprinkled with anecdotes and illustrations. Students, appreciative of this finesse in preparation, praise and popularize the instructor, yet, in so doing, fail to master the subject themselves. Laboratory must be held on Tuesday and Thursday, as that is the time when the schedule permits a double period for such work.

Contrast with the above the child-centered, socialized classroom where the teaching concerns itself with the needs, abilities, and interests of the students, and devises ways and means for helping these boys and girls adjust themselves to their environment. The unit method, contract method, problem method, or teacher-made guide sheets and worksheets are used extensively to increase the student's activity and to get him to learn more effectively. Laboratory work is not divorced from regular class activity; laboratory work is done when it is needed for obtaining data in the solution of a problem, for checking the conclusion or applying the principle.

Purpose

IN THE FALL of 1940 the author had two classes in General Biology in Edgar High School. An examination of the class rolls of each revealed them to be approximately equal in so far as age and mental development, as shown by Kuhlman-Anderson mental test, were concerned. The school possessed two sets of textbooks, New General Biology, by Smallwood, Reveley, and Bailey, and Everyday Problems in Biology by Pieper, Beauchamp, and Frank. The former book met the requirements for the formal type of biology teaching, while the latter was organized along the newer technique as advanced by Morrison of the University of Chicago. The writer is familiar with both methods of teaching Thus the set-up was complete for the testing of the relative effectiveness of the "old" against the "new." We could say, the purpose of the experiment was to set up, in so far as is humanly possible, two groups of equated students, teach each by a radically different method, and by a series of tests determine the progress made by each group.

Procedure

Group I, the formal group, followed the text, New General Biology, very closely. They were given page assignments, had factual tests several times a week, and made no effort to use reference materials or do outside reading although several of the students did use the library quite freely. They had the laboratory manual which followed the text and performed the experiments it contained in regular class laboratory periods.

Group II, the socialized group, used as a basic text, Everyday Problems in Biology by Pieper, Beauchamp, and Frank. Study outlines and worksheets constructed by the author were used. These study sheets utilized several texts and reference materials. The Unit was the basis of studying a problem. The Unit, as employed in the class, followed Morrison's quite closely in that each was studied in five distinct stages, viz: (1) Exploration, using the "sounding out" process for determining previous experience and correlating this with the unit. (2) Presentation by the teacher of the phase of subject matter studied, followed by a test to determine whether the presentation had been effective; then representation, covering material not at first understood. (3) Assimilation by students of the various details bearing upon the unit. This takes the form of reference and experimental work, as well as closely supervised individual and group study. (4) Organization. Without notes, students turn their attention to summing up in logical sequence the material assimilated. (5) Individual recitation, oral and written, was the final step in the plan used.

Both Group I and Group II were given the Cooperative test in Biology constructed by the Cooperative Test Service of the American Council on Education at the beginning of their study of biology and a different form of the same test at the completion of their work in the spring.

THE IOWA Silent Reading Test was given to both groups at the end of the first six weeks in an attempt to make a correlation between the ability to read and progress made in biology.

A test was devised by the author and administered to both groups which attempted to measure the attitudes and appreciations as well as the ability to generalize. It contained thought questions to test their reactions to various situations and superstitions.

Both groups had field trips and excursions to places of biological interest. Carefully prepared directions were made for these field trips, notes were kept by each group and a written summary or discussion was required afterwards of everyone.

Outcomes and Conclusions

The outcomes and statistical results of this study hold true for this particular group only and due to the fact that the group couldn't be called a representative sampling of students wouldn't be valid for every biology class. Furthermore, the groups were too small to employ with any degree of validity or reliability the various statistical measures. The writer, however, is of the opinion that the general conclusions drawn from the study are fairly valid and would possibly be borne out by a more exhaustive study.

OUTCOME: (1) There was a close relationship between the Iowa Silent Reading Test and the progress made by both groups as determined by scores made in the Cooperative Test in Biology. Group II, the socialized group, showed a wider range of scores; that is, the student with the highest reading score in that group made much more progress in biology than the corresponding student in Group I, while the student in Group I, the formal group, with the lowest reading score, made more progress than the correspondingly low student in Group II.

(2) When the results of the Kuhl-

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Miniature Slide and Film Strips

CHARLES I. HELLMAN

Bronx High School of Science New York, New York

IN THE "Good Old Days" the lantern slide was widely used as a visual aid in the classroom and a source of entertainment in the drawing room. The popularity of the motion picture has generally displaced the use of the lantern slides. This is most unfortunate because the lantern slide can make a contribution to teaching that the motion picture cannot adequately make.

The advantages of the lantern slide as a visual aid are:

1. Due to its larger size, the sharpness of the projected image is greater.
2. It is easy to arrange a set of slides in any order.
3. A single slide can be shown whenever necessary to illustrate a point.
4. The image produced by the lantern slide projector is bright enough to be used in a poorly darkened room.
5. It is feasible to make lantern slides to fit each teacher's needs.

THE GREAT popularity of the miniature camera has made available to the teacher a simple and inexpensive source of miniature lantern slides (2"x2") and filmstrips. These small slides are so small that 100 of them can be stored in the same space required to hold 25 standard slides. Filmstrips have the advantage of even greater compactness.

The availability of the equipment and low cost of the materials make it possible for the instructor to have slides of what he wants, when he wants it. The possibility of meeting individual needs of the instructor is thus made a probability.

The usual way of making lantern slides is to photograph the subject matter and then to obtain a negative. This negative is then printed upon a lantern slide which is used for projection. In practice this method presents many difficulties. Dust upon the negative and positive material, faulty contact in printing, and improper printing exposure are some of the bug-a-boos that threaten the slide maker.

The Method of Direct Reversal

THE METHOD of direct reversal makes it possible to dispose of these difficulties since film that is used for taking the original picture is made into a positive without the need of a printing step.

Direct reversal of film is generally used in the processing of amateur motion pictures. The basic steps of this procedure are: exposure in the camera, development, bleaching of the image, clearing, exposure to white light and the second development.

Although it is generally recommended that only special films be used for reversal, this writer decided to find out whether positive would work. This film was chosen because of its low cost (2c per ft.) and easy handling, as it can be handled under the bright orange-green (Wratten OA) safelight. Its gradation furthermore is particularly suited to copying photographs, diagrams, charts, and other printed matter.

In making up the processing solutions, it was found possible to use the photographic formulae that are found in almost every darkroom. The complete time table and formulas used in this process are given at the end of the article. It has been used many times and gives excellent results. The inexpensive roll film tanks that accommodate 5 feet of film are used in the processing.

General Suggestions

THE MATERIAL to be made into projection strips should be copied, using the normal copying procedure with two reflectors. The correct exposure, however, is important and should be based on an electric exposure meter reading. Once the correct set-up is found it will be simple to produce good results in quantity.

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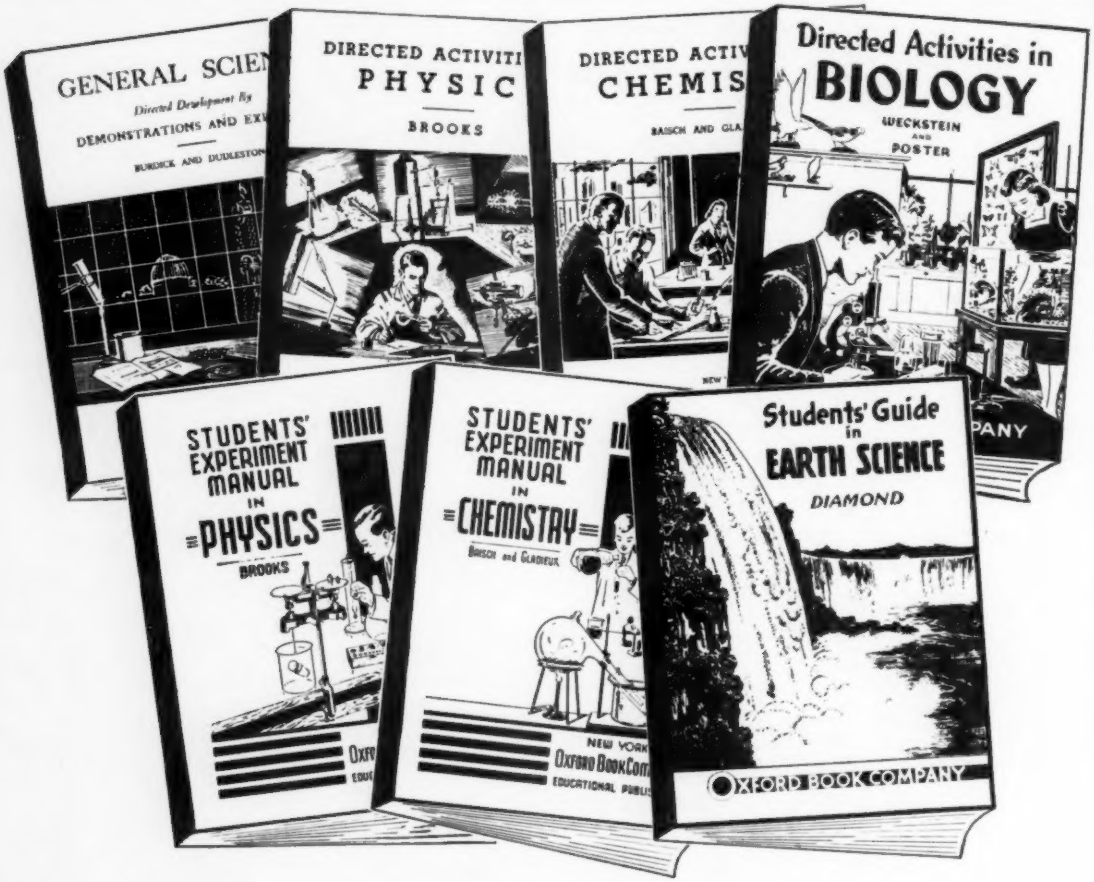

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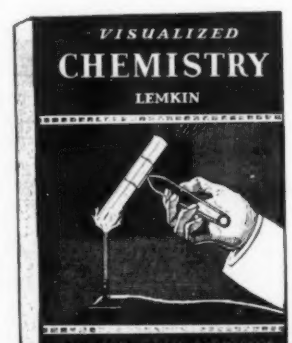

VISUALIZED
CHEMISTRY
LEMKIN
OXFORD BOOK COMPANY

Some Projects in Consumer Chemistry

M. C. CREW

Austin High School Chicago, Illinois

"It is not surprising that the consumer today gets so little for his dollar. The wonder is that he gets as much as he does. Think it over for a few minutes. Many large interests are arrayed against you. The manufacturers are able to employ the ablest men — from chemists to psychologists — to fool you. The merchants can employ the ablest literary and artistic brains to prepare advertisements to mislead you. The publishers of newspapers and magazines, whose income depends upon these advertisements, are almost forced to shade their news column to aid the seller of the goods rather than the buyer. This applies even to your small investments in case you have a dollar left over after all the various vultures have had a turn at you. Railroads, lawyers, doctors and candlestick makers all seem combined to milk you.

The present profit system may be facing a death sentence unless something is done for the consumer. The men and women of America will not forever tolerate such economic practices as destroying livestock, plowing under cotton, dumping milk in the gutter, burning grain, and systematically operating the industrial plant below its full capacity.

Labor division, machinery, power and other technical progress have demolished the old economy of scarcity. Consumers are demanding in its place the creation of an economy of abundance. . . . All that an economy of abundance implies is the operation of the economic plant at normal capacity and the continuous expansion of that plant with continuous invention and discovery. Consumers do not ask for Utopia. All they require is the elimination of sabotage in all its forms."— Roger W. Babson.

CONSUMER chemistry was originated to help meet the science needs of the pupils. Many pupils have no intention of taking college training for scientific or technical careers for which the more familiar science in chemistry and physics are preparation. What these students need is some practical work in chemistry that will at least give them a background to meet the problems of buying supplies and materials in their future life. The bibliography at the end of the article referred to above, will give some idea as to what extent Consumer Chemistry has been taught in recent years in the United States.

Attached you will find two typical Consumer Chemistry Projects. In addition to these a number of other projects have been developed by the students. The most important of which are:

1. The proximate analysis of coal. (A modified form of the United States Bureau of Standards method has been developed which gives fairly consistent results for the volatile matter determination. Heating 1% grams of coal in a porcelain crucible for eleven minutes, to a red heat, with a Bunson Burner flame about 2" high has been found to be satisfactory.
2. A comparison of common water softeners. (The amounts of washing soda, borax, and tri-sodium phosphate needed to soften water from Lake Michigan to various degrees of softness can be easily determined, as well as the cost to soften fifteen gallons of water, the average capacity of a washing machine.)
3. The amount of moisture in soap. (This is easily determined by weighing a four or five gram sample, drying it in an electric oven for several days at low temperature, and then weighing.)
4. The determination of various fractions in certain gasolines. (It is quite a simple matter to find the initial boiling point and the proportion of gasoline that will boil over between various ranges of temperature. A comparison of the results give indication of the gasolines' starting properties in cold weather.)
5. A comparison of flash points for various automobile lubricating oils. (Done by the standard flash point method.)
6. The making of tooth powder. (According to certain recommended standards such as found in Henley's

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Use of Library in Teaching Science

GLEN C. TILBURY

Urbana High School

Urbana, Illinois

CONCERNING books, Dr. Charles W. Eliot, former president of Harvard University and an outstanding chemist, once wrote:

"Books are the quickest and most constant of friends; they are the most accessible and wisest of counsellors, and the most patient of teachers."

In looking ahead, it is most believable that our boys and girls will have an abundance of leisure time and for the majority of them, the public library is the only university they will ever know. In the light of this, it seems quite conceivable that Dr. Eliot would advise this generation of chemistry teachers to bring our students into friendly contact with the many appealing works of science found in books and periodicals. Teachers, I believe, would generally agree with Dr. Eliot.

Granted that we believe in the use of reference materials and that we have them available, there is still the question of how best to introduce this field of science literature to a chemistry class.

SURELY, we all know that English and history departments make wide use of library materials and seemingly have their methods well in hand. But what of the methods to be used by science teachers? A few years ago, I looked through science teaching methods books and magazines only to find there were no methods listed. At that time, I started scouting to collect and try out the methods that I will discuss.

One method of introducing books to a class is the following: Set aside a double period for the purpose of browsing. Have on the table before the class many, perhaps fifty or sixty, interesting books in science. I would not confine this to chemistry. I say interesting; however, what would interest some would not perhaps interest others. It is for that reason one should have many books for the introduction. Let the class browse for the double period. Many times one will find the students will like the book so well, he will check it out of the library. Frequently, a student will develop a lasting interest in some particular phase of science by this browsing process.

FOR THIS first introduction, a report of their reading need not be required. However, the teacher, if he or she wants a check-up, could tell the class at the beginning that they should write just one paragraph on "Why I Liked the Book" or "Why I Did Not Like the Book." If, instead of asking for a reaction concerning the interest of the book, one could ask for a brief summary of it. Or one can interrupt the reading about ten minutes before the end of the period and ask different ones, "What did you read?" "How did you like it?" "Tell us a little about it." Many times, it will be found other members of the class will wish to read the same article. The class may be told that reading of this sort can be done and reported on for extra credit. Personally, I feel this first exposure to library books will be more enjoyable — the class will get more of a thrill from it, if they are not frustrated with the writing of a report. A teacher may find it successful to use this free reading period more than once. There are usually some ways which cannot be used to introduce a new unit. Such may be the case before a vacation. In this free reading period, the student may decide to check out a book for the vacation.

In conversation before class, or after, in the halls, one can casually refer to the book the student has read. Demonstrate to the student by your words and enthusiasm that you too have a high regard for the particular book (if you do).

CERTAINLY, a class should be shown where in the library the chemistry books may be found. In fact, a period

could be used in which the student would look up in the library the answer to his questions. As a matter of fact, the library should be looked upon as a place where many questions can be answered. However, we teachers know that not all students have questions, at least questions intriguing enough to force the student into the library. If, however, we supply a question the student accepts, he still has the advantage of systematically searching the library for an answer. The ideal thing probably would be for a student to originate a question, then go to the library to seek the answer. I believe we should not depend upon this hapless situation, but instead should use definite ways of bringing the student in contact with the reservoir of science literature.

A method of quickly bringing the student in contact with several books is to put a book in the hands of each member of the class, and tell them that each should examine his book as he wishes for five minutes. At the end of this brief period, the teacher will indicate for each student to hand the book to the person sitting on his right (or left) and so continue for the period. In that way, a student is given opportunity to examine at least eight books in a single period. Usually one of the eight will strike his fancy, and perhaps be a book he will derive much satisfaction from later on.

ANOTHER method is to make use of the interest aroused by Book Week, which comes in the Fall. Previous to the time the teacher can find out in some way if any members of the class have read interesting science books. Almost always in a class you will find some one who has read "Microbe Hunters" or "Life of Madam Curie." The first five or ten minutes of each class period during Book Week may be set aside for a review of one of these books given by a student. This will be good advertising for the book and will also give the student some well deserved social approval. After hearing some of these reviews, some students may decide they should like to use one for a book report. Incidentally, members of the English department will be glad to indicate what science books they would accept for book reports.

SPEAKING of correlating English with science, it also should be mentioned that students in English sometimes may prefer to write short themes or term papers on science topics. The English department will welcome a list of topics. Some topics which have been used for term papers by English students taking chemistry are "Cellophane: Magic Film of Industry," "Nylon, the New Synthetic Wonder Fiber," and "Plastics." One history student wrote a term paper, "The Part Chemistry Plays in American History." This also may prove to be a subject through which increased reading of science literature may come about.

Another method is to prepare typewritten, interesting, and appealing excerpts from science books. These are posted with the name of the book for each excerpt in some place, such as on the bulletin board or in front of the pencil sharpener, where they will be seen. The student reading the excerpt may be stimulated to go to the library after the book. This method may have a future. I have found, however, by checking with the librarian, that this method is not so successful. Perhaps it is not attractive enough.

A MUCH more effective way is to place on the bulletin board or upon an attractive poster a display of ten to fifteen colored book covers of late science books. The covers obtained may be from the library. A brief review of the book obtained from the book cover can be posted with it. A student, perhaps one who is artistically inclined, can volunteer or be asked to arrange these along with an attractive title of the display. This can be kept in the room for a week or two, and then transferred to another science room.

Along the line of displays can be mentioned the display of chemicals which

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Peace Time Explosives

RALPH K. CARLETON AND SHELDON L. SALISBURY

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(Continued from October issue)

THE TESTING of explosives constitutes an important branch of the explosives industry and employs a great many technical men, who are usually chemists, physicists, and chemical engineers. This testing may be divided into chemical tests and physical tests.

All explosive plants have routine chemical laboratories which are constantly analyzing the raw materials going into the process, to insure that they meet quality and strength specifications. These laboratories also furnish information for strengthening the spent acids, and analyze samples of completed products. In addition, the explosives companies have central research laboratories where new explosives are evolved, old ones improved, and all the complaints and competitive explosives examined. Materials used in explosives are composed entirely of two classes: (1) those that give off ogygen when they undergo reaction, and (2) those that take up ogygen. Thus in designing an explosive it is attempted to control the relative proportions of these two classes so that a neutral or slightly positive ogygen balance of the paper shell and its paraffin coating is taken into account as well as the dynamite ingredients. With a proper oxygen balance, the gases given off by the explosive are composed almost entirely of carbon dioxide, nitrogen and water. When a powder is not properly balanced, carbon monoxide and oxides of nitrogen are found in the gases of decomposition, and, as these gases are extremely toxic, they are objectionable for use in closed areas such as mines. Gas analyses are always made to determine the products of combustion, and at times the solid products of combustion, if any, are also analyzed.

COMPLETE physical tests are made on explosives to determine their explosive properties. Some of these tests will now be described briefly. The pressure developed is ascertained by exploding a measured quantity of explosive in a pressure bomb known as a Bichel Gage, which is fitted with a pressure-recording gage similar to the Crosby engine indicator, the drum with chart being revolved at a definite speed by an electric motor. The actual strengths of the explosives are determined by means of ballistic pendulums or ballistic mortars. These strengths are sometimes referred to as "unit deflecting charges" and represent the weight of an explosive that will produce a deflection of the pendulum to the same degree as a standard weight of a standard explosive. The ballistic pendulum consists of two parts, (1) a cannon in which the explosive is fired, and (2) a pendulum which receives the impact of the products of explosion and stemming. The ballistic mortar is similar to the ballistic pendulum except that its weight is much less, and the explosive is stemmed with a cylindrical steel shot which is projected from the mortar.

OTHER factors being the same, the velocity or rate of detonation of an explosive determines its shattering effect. The velocities are measured in several ways, the most common one being the use of the Mettegang recorder. This consists of a soot-covered rotating drum, a vibration tachometer for measuring the speed of the drum, and an induction coil with terminals so connected that it projects sparks on the soot-covered drum. Wires inserted at measured distances apart in the explosives are connected to the recorder, and the time interval between the rupturing of the two wires is found from the marks on the rotating drum. Another method of recording the velocity is by means of a special camera having a rotating drum on which a film

is attached, or by a camera having a stationary film and a revolving mirror. A third and relatively simple method of measuring velocities is that of d'Autriche, in which the unknown explosive speed is compared to that of a detonating fuse of known speed.

Other physical tests, all of which require special equipment, are those for determining (1) impact sensitivity, (2) friction sensitivity, (3) duration and length of flame, and (4) the measurement of the pressure waves sent out by an explosive.

Uses of Explosives

A STUDY of this industry would be incomplete without references to the uses of explosives. This is most readily accomplished by considering briefly first the methods of using explosives, and, secondly, the fields in which explosives are employed.

The early use of explosives was attended with many dangers, one of the greatest being caused by the lack of a good means of providing a time interval between applying the fire and the subsequent explosion. This problem was solved in a very satisfactory way by the Englishman, William Bickford, in 1831 through his invention of a safety fuse. A safety fuse consists of a powder train surrounded by various textile and waterproofing materials, and presents the appearance of an insulated electrical wire. The fuse has the purpose of carrying fire to the charge at a predetermined rate. Although present-day fuses are still made on this same principle, they have been greatly improved in all respects, and have remarkable burning regularity under various conditions of use. When safety fuse is employed in blastings, the method is referred to as the fuse and cap method. To initiate a charge of dynamite, a detonator is crimped on the end of a piece of fuse of required length. This capped fuse is inserted in a dynamite cartridge after a hole has been punched in it. The fuse is then tied to the dynamite cartridge and the assembly constitutes what is known as a primer. The primers are placed in drilled holes at the mine face and pushed into position with a wooden pole, the fuse extending well beyond the face. Other dynamite cartridges are pushed into the drill-hole until the required number is obtained. This operation is followed by the plugging of the hole, usually with clay or other handy, easily packed material, which is called tamping or stemming. The tamping eliminates the danger of a blown-out shot and increases the efficiency of the explosive. When black powder is to be ignited by means of a fuse, it is not necessary to use a detonating cap. Fuses are ignited by means of special lighters of various types or by open lights.

IN THE electric method of detonation, electric blasting caps or E. B. caps, as they are commonly called, are used in place of fuse and caps. These caps differ from fuse caps in that they are sealed and have two leg-wires extending from them by which means they are connected to a source of current and to various electrical hook-ups. The present-day caps are of the low tension types, in which a platinum bridge-wire is heated to incandescence and thus ignites the priming and detonating compounds in the caps.

The bulk of explosives produced in the United States are consumed chiefly by the mining, quarrying, and construction industries. However, they are also used in less quantities for agricultural work, in lumbering, in producing oil-wells, and in demolishing old buildings. According to the United States Bureau of Mines Report of Investigations No. 3350, the production of explosives in the United States in 1936, listed according to classes was as follows:

Black powders, approx.	82,000,000 lbs.
High Explosives, app.	262,000,000 lbs.
Permissibles, approx.	48,000,000 lbs.
Total, approximately	392,000,000 lbs.

The use of these explosives is approxi-

mately accounted for by the information in Table I.

Table I

Industry	Black Powder %	Per-mis-sibles %	High Ex-plosives %
Coal mines	87	98	9
Metal mines	1	--	29
Quarries and other non-metallic mineral mines	3	1	19
Railroad and other construction	9	--	38
Miscellaneous	--	1	5
Totals	100	100	100

NEW USES for explosives are constantly coming to light. Two of the most important of these are (1) in geophysical prospecting, and (2) in accelerating swamp fill. Geophysical prospecting, or exploring down as it is called sometimes, is a method of determining and plotting the substructure from the surface of the earth. When an explosive is detonated it sets up seismic or elastic earth waves so that it is comparable to a miniature earthquake, and seismographs record these waves. If the vibrations of these waves are recorded from a distance, it will be found that a part of the energy travels at the ground surface, a part is refracted should there be a harder medium below, and a part will be reflected from interface between the formations. Therefore, the two methods of prospecting are known as refraction and reflection. By measuring the speed, magnitude, and character of these waves, a knowledge of the substructure is obtained, and it is possible to predict the location of sulfur, salt, oil, gas, and metals with considerable accuracy.

Modern highways are frequently built over swampy and marshy land on which it is impossible to obtain a satisfactory permanent footing. By exploding charges of dynamite in such areas, the muck, or other unstable material, is blasted away to permit a fill to be placed on a firm, hard bottom which will result in a permanent stable roadbed.

Modern Industrial Significance

THE HISTORY of civilization is closely linked up with the history of the explosives industry, and for almost every advance made in explosives development corresponding progress has resulted in the advancement of man's physical environment. Civilization as we know it today would have been impossible without the aid of explosives, and it is only through their use that the mining industry and the metal industry have gone forward to their present positions. In the United States, 62,000 ounces of silver were produced in 1860. Nobel made the first dynamite in 1867; by 1870 the output of silver advanced to 10,000,000 ounces. In 1869, before dynamite was regularly adopted for mining of copper ore, the production was 72,000 tons, while in 1935 about 19,000,000 tons of ore were mined. These figures, of course, vary with general industrial conditions, but it can be readily realized that the tremendous advances made since the middle of the nineteenth century would not have been possible without the use of explosives.

IN THE early days of explosives manufacturing history there were numerous small manufacturers. During the latter half of the nineteenth century and around the early part of the twentieth century a period of general business expansion took place, in which many small companies were absorbed by larger ones. The explosives industry shared in this expansion. By 1907 the government considered that the duPont Company dominated the explosives manufacturing field and instigated suit under the Sherman anti-trust Act. In 1912 the duPont Company was dissolved into the three companies, (1) duPont, (2) Atlas, and (3) Hercules. These three companies, together with the explosives division of the American Cyanamid and Chemical Corporation, which division was organized in 1933, are the largest present day manufacturers of explosives; accordingly, the modern growth of this industry has taken place during the past twenty-five years. Both the Atlas and Hercules

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Program

OF THE AMERICAN SCIENCE TEACHERS ASSOCIATION AT DALLAS, TEXAS

December 29th, 30th and 31st, 1941

President, Ralph K. Watkins; University of Missouri, Columbia, Mo.
Vice-President, Morris Meister; Bronx High School of Science, New York, N. Y. (Chairman of Program Committee)
Secretary, Deborah M. Russell; State Teachers College, Framingham, Mass.

Monday morning and afternoon, December 29. Members are invited to attend the meetings of the National Association of Biology Teachers at Jefferson Hotel.

Monday evening, December 29, at 6:30 p. m. Board of Directors Dinner and Conference, Hotel Adolphus.
Presiding: Dr. Ralph K. Watkins.
(Note: Arrangements to be made by Watkins and Russell)

Tuesday morning, December 30. Members are invited to attend the meeting of the American Nature Study Society at the Jefferson Hotel.

Tuesday noon, December 30, 12:30 p. m. Annual Luncheon, Hotel Adolphus.
Presiding: Dr. Otis W. Caldwell.
Speaker: Dr. Irving Langmuir, president of The American Association for the Advancement of Science. (Note: Topic of Dr. Laugmuir's address to be provided by Dr. Caldwell).

Tuesday afternoon, December 30, 2 p. m.; Ballroom, Hotel Adolphus.
Presiding: Dr. Ralph K. Watkins.
Symposium: Science in the Service of Youth in a Democracy.
Speakers: A. Dr. Watson Davis, Director Science Service: "The Science Clubs of America.."
Discussion:
Dr. L. J. Thomas, University of Illinois.
(Note: The following have been invited to take part; they have not yet replied: Dr. Howard E. Enders, University of Indiana; Dr. Karl F. Oerlein, State Teachers College, California, Pa.)
B. Mr. Sigman Hayes, sponsor Raymond Ditmars Scientific Society: "Texas Scientists, New Crop."
Prize-winning Papers by Members of the Junior Academy in Texas, as follows:
"Arterial Injections and Injection Masses." Lola Lee Dyess, Honorary Member A.A.A.S.
"Wood Technology." Mathis Blackstock, President Austin Junior Academy of Science.
"Beautiful Texas." Patsy Tucker, Secretary Austin Junior Academy of Science.
C. Dr. Morris Meister, Principal of the High School of Science in New York City: "An Experiment With a Program of Science Education for High School Boys."
The annual business meeting will immediately follow the symposium session.

Wednesday morning and afternoon, December 31. Members are invited to attend the meetings of The American Nature Study Society at the Jefferson Hotel.

All who are interested are cordially invited to attend. For further details, please address the secretary..

SCIENTIST AND CONSUMER

(Continued from page 11)

Absurd premiums are charged for alleged fancy quality, fancy bottles, exaggerated cleanliness, superfluous fat. Consumers are persuaded to pay two and three dollars a pound for butter when they buy it in the form of a little extra butterfat in a fancy milk. More service is piled on top of the milk bottle than a great many consumers need or can pay for. So they buy less milk than they need. The city end of the milk business could be performed for low-income consumers at 3 cents, or even less, per quart. But it is being done at 5, 6 and 7 cents a quart because dealers are not interested in developing low-cost low-service methods of distribution suitable to the requirements of the majority of city people.

THEN here's a different sort of example of distribution cost. A manufacturer of men's hats reports to the Twentieth Century Fund that he makes a hat to retail at $3.50 on which the factory cost is $1.70; and he makes a better hat to retail at $10.00 on which the factory cost is $3.74. Two dollars more to make it, six-fifty more to buy it. To be sure, only the rare male buys a $10.00 hat. Well, then, take two cotton dresses selling at $1.95 and $2.95. That's a dollar difference, but the difference in factory cost is only 34 cents, and neither of these dresses is a luxury article. These are the extra distribution costs on quality products which consumers are ever and forever being urged to buy.

One reason why added distribution burdens can be imposed on consumers is that they do not know how much they pay for extra quality, or alleged quality, or for each added service feature. A Massachusetts study of installment selling found that out of 106 contracts on which the interest charge was stated to be 6 per cent, there were 33 with an interest rate of 24 percent or more and on 13 of these the interest rate was more than 50 percent. Consumers pay such interest rates because they don't know they are paying them. If they knew what every extra distribution service cost, they would decide in many cases to buy the product without the service, or to do without. Then we might see some progress in the development of plain distribution methods on plain products to serve plain people.

THAT BRINGS us to the consumer's second concern about this 60 cents of every dollar that goes for distribution. He wants to be sure he knows what he is buying and gets what he wants. That is, he wants to be able to identify the quality facts of the various commodities offered, and compare them, and compare their prices, and decide which is the best buy for him. Here he is in a quandary indeed, and this is where the scientist can come to his aid.

He is urged to buy by brand name. Good. But in many instances the identically same product is put up under several brand names. Then there are so many brand names in every commodity line. In Milwaukee in 1939, for instance, there were 127 brands of packaged coffee, 225 brands of canned peas, 107 brands of peanut butter. Then again the branded product may be just the garden-run product marked up in price because it has a special name on it. From the American Druggist I learn that in July 1938 the standard drug barbital was selling at 56 cents an ounce wholesale, but at $3.00 an ounce when it was called Veronal. Phenobarbital was selling at 57 cents an ounce when you called it by that standard name, but had a wholesale price of $6.90 per ounce when you called it by its private name, Luminal.

IT'S APPROPRIATE to repeat here something I said in an article published last year. 1/

1/"Consumer Standards and Marketing," Annals of the American Academy of Political and Social Science, May, 1940.

"Consumers are told that reliable brands carry with them the reputation and good faith of the concerns that own them. This begs the question. Granting

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FUNCTIONAL BIOLOGY COURSE

(Continued from page 3)

A THIRD opportunity for making the biological sciences functional is that of contributing to the development of worthwhile, interesting, or useful hobbies. Of the students now enrolled in your biology classes, how many have or are actually developing certain interests which become hobbies with them? To what extent do you encourage their participation in junior or adult groups in the community? How many have become interested in caring for pets, be they cats, dogs, canaries, or even snakes? In the Irving Junior High School in my home community, we have a very large number of students just now who first became interested in white rats but who more recently have taken up the cultivation of snakes. At the Student Union Building on the University of Nebraska campus, this past week there was a very interesting display of snakes or reptiles which these high school students had been promoting as a hobby or specialized interest. How many of your students have become interested in hybridization and the development of select and improved grains, plants, flowers, and the like? Have any of your students become iris fanciers or rose growers? Have these boys and girls become interested in woodland vegetation, mosses, lichens or ferns? How many have become concerned with the preservation of the American Elm? Do they know that the beautiful American Elm tree is rapidly dying out and that in certain areas of the country they are now no longer found? Why should not such interests as these just mentioned become the major outcomes of biological science instruction? Such interests as these become most worthy leisure time activities and afford recreational opportunities, the value of which cannot be doubted at all and the contributions of which to the keener enjoyment of life will everywhere be evidenced. It is not that we doubt the value of these outcomes. It is rather that we have become so obsessed with our subject-matter presentation we find it difficult to think in terms of larger and, what I personally believe are the most fruitful, valuable, and interesting outcomes.

ONCE MORE, the biological science instructor is confronted with her responsibility, or his responsibility, in contributing to the development of vocational interests and affording a training that will insure more vocational opportunity. Two young men of my personal acquaintance became most successful business men in my community as growers of nursery and greenhouse stock. Another young man became especially interested in forestry and recently moved to Colorado where he purchased a small nursery and during the past two years has developed a very thriving business. As a youth in school, he had no idea whatever of becoming such. The stimulus of a biological science instructor was all that was needed to start him on the road to business success and a vocational future. Why should not there be an emphasis on these matters? I would consider it your responsibility and a very necessary one to bring to every student's attention the many avenues of employment that will open to them and to stimulate in them a determination to qualify to the greatest degree possible. We have not been sufficiently conscious of our responsibility in this regard.

Thus far, I have said nothing concerning the importance of the biological sciences as a contributing factor in the development of habits of scientific and reflective thinking, of clear-cut analysis, of orderly arrangement, of work activities, of developing right mental attitudes. Outcomes such as these need no defense. The important thing that I would emphasize is that such outcomes can be insured through a functional program as much and more as through the traditional program. It is my firm belief that they are easier of attainment where appeals to interest and need are recognized.

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PRECIOUS STONES

(Continued from page 7)

to appeal to the public to the extent that ruby is much more popular than sapphire in this field. As far as physical properties are concerned, however, most authorities agree that sapphire, if anything, is somewhat superior to ruby for watch jewels and instrument bearings.

One of the most interesting things about sapphire and ruby is the success with which they have been produced synthetically. The process itself is fascinating, but even more fascinating is the thought of producing jewels synthetically on a mass production basis — jewels that are larger and more homogeneous than those formed by nature and, incidentally, much cheaper. While the method of producing corundum artificially still depends upon human skill and, as such, does not lend itself to mass production, a considerable volume of stones is made this way and the indications are that this volume is increasing rapidly.

In the process of fusing aluminum oxide to form synthetic sapphire or ruby, the powdered oxide is fed gradually to an inverted blowpipe enclosed in a small furnace. The flame of the blowpipe, formed by the combustion of a mixture of oxygen and hydrogen delivered through the pipe, melts the powdered oxide and at the same time furnishes heat with which to maintain a proper furnace temperature. As the oxide fuses it falls to a small clay rod placed in the furnace under the blowpipe mouth and gradually accumulates to form a so-called "boule." (Fig. 1). The boule is then cut as desired with a diamond-charged copper disc operated at high speed.

NATURE, evidently, has not been able to control her manufacturing conditions as well as man, for her stones frequently lack uniformity of structure and color and generally contain various kinds of inclusions, foreign matter and internal strains. Those of her specimens that are perfect are valued so highly as gem stones that the engineer finds them practically unavailable as engineering materials. Man, by his process, is able to produce stones that are consistently homo-

Table II

Precious Stones Used in Industry

Stone	Composition	Hardness (Moh scale)	Typical Applications	Source
Garnet	$R_3R'_2(SiO_4)_3$ R is Ca, Mg, Mn, Fe R' is Al, Cr, Fe	6.5 to 7.5	Abrasive paper and cloth Bearings for inexpensive compasses, watches and electric meters	Eastern U S.
Amethyst Topaz	SiO_2 with Mn and Fe oxides	7	Bearings for light mechanisms Recording needles	India, Ceylon, Brazil, Siberia
Sapphire	Al_2O_3 with titanic oxide	9	Bearings for fine watches and instruments Wearing points Recording needles	India, Asia Minor, S. Africa
Ruby	Al_2O_3 with chromic oxide	9	Similar to those for sapphire	India, Asia Minor, S. Africa
Diamond	Pure carbon with oxide coloring	10	Abrasive powder Cutting edges for tools Drawing dies Hardness tester points Scratching tools Nozzles	S. Africa, Brazil, East Indies, India

geneous and free from all inclusions and residual stresses. His stones can be colored or made colorless (colored stones are not as hard as the colorless ones); they can be sawed and cut without comparative difficulty; and they are generally more reliable and longer-lived than their natural rivals.

Diamond

Although man has been able to improve on nature in a great many respects, he has not been able to produce a material harder than diamond. In fact, he has not yet been able to produce diamond artificially, except as a laboratory curiosity.

Diamond, in all of its forms, consists of pure carbon colored by minute traces of oxides and other impurities. Its hardness of 10 marks the top of the Moh scale. This extreme hardness, supplemented as it is by its strength, makes diamond an ideal abrasive and cutting material. Rock drills and metal cutting tools are set with diamonds on their cutting faces. Hones, laps and polishing wheels are impregnated with diamond dust for finishing hard materials. Hardness testers and scribes make use of diamond points where great pressure and wear are expected. Drawing dies for wire and nozzles for diesel fuel injectors are made of diamond to combat high rates of wear and erosion.

INDUSTRIAL diamonds consist of several forms. Gem stones, being the most expensive of all the types of diamond, are used for industrial purposes only where particular properties are required. Their perfectly crystallized structures frequently are subject to inherent weakness along cleavage planes. Cleavage plates, sections between such planes, or "flats" as they are called, are often used for drawing dies. The most common industrial diamonds, known as "bortz," possess imperfect or random crystalline formation and, consequently, are practically free of cleavage weakness and are not likely to split under load. Fine round particles of bortz are called "ballas." Carbonados, the third main group, are the so-called black diamonds. They seem to be composed of compact clusters of small crystals and are likewise quite uniform in strength.

So far as industrial applications are concerned, the diamond leads all the precious stones in popularity and usefulness. There are, however, specific spheres of application for each of the rare stones and it is becoming increasingly important that our budding scientists and engineers appreciate their tremendous potentialities. Too little, indeed, is known about the individual physical properties of thes ematerials. The field of research and investigation in this subject is a most fertile one, promising not only an intensely interesting vocation but one which will draw ready recognition from the engineering and scientific world.

OHIO JUNIOR ACADEMY

A TRIAL Junior Academy of Science meeting for students in Ohio was held in the spring of 1940 in connection with the fiftieth anniversary celebration of the Ohio Academy of Science. As a result of this trial meeting a formal constitution was drawn up and temporary officers elected.

On April 13, 1941, the first regular meeting was held at the Case School of Applied Science in Cleveland. Around seventy-five students participated with papers, exhibits and demonstrations. The idea of having district meetings in the fall with a state meeting in the spring was discussed and tentative plans were made for them.

The officers of the organization for 1941-42 are: Dr. C. W. Jarvis, chairman, Ohio Wesleyan University; Orval L. Linebrink, secretary-treasurer, East High School, Columbus; J. W. Branson, assistant secretary-treasurer, West High School, Columbus. There is also an advisory council composed of senior academy members, representing the different districts of the state.

USE OF LIBRARY

(Continued from page 23)

will illustrate late developments in chemistry. Students may volunteer or be asked to arrange such a display. With the display should be references telling where the students can read more about the chemicals displayed. This display can be attractively arranged and placed in the library in a prominent place. Our librarian welcomes such displays. Other departments of the school supply exhibits. With the exhibit in the library, virtually the entire school is exposed to some of the contributions of chemistry. Some titles for displays are "Plastics," "Strategic Materials," "Metals," and others.

IN THE biology classes of the University of Chicago High School the students are given at the beginning of the class on Monday "A Bright Monday Sermon." Their belief is "A good start is half the race." At this time topics in biology are presented. Why not, in general, in our science class, make our start for the week by introducing interesting articles from a science magazine or an interesting chapter from a science book? This serves as an excellent start for the week.

The following is a method which may well be used before a vacation. Give the students a long list of interesting science books that can be found in the library. This can be compiled in a very short time by having a typist, right in the library, type the titles of the books as you take them from the shelf. When this list is given them, each is to look over the entire list and mark the books each has read. This makes sure each title is observed. Otherwise, a book appealing to some student could be easily overlooked. When the class has checked the list, ask how many have read three of them, or some other number. Those who have responded may be asked the names of the books, whether they liked them, which was the most interesting. This helps introduce these books to others. Students later may or may not be asked what books in the list they have read. However, a check-up with the librarian will give one a quick answer as to whether or not the method has been successful.

MUCH reference so far has been made to science literature in general. Some of our students taking chemistry have little introduction to other sciences and in the reading which I have been referring to, I believe the student should be permitted to jump subject matter barriers and sample material in all sciences.

In the chemistry class, there is one method which is used quite widely. At the proper time, the teacher reads a portion of a book (a page or two), and at the proper place stops. As an example, after reading from "Creative Chemistry" in the chapter on Plastics, what student is there who would not like to read more after listening to two pages of the work of John Wesley Hiett? Or, in the same book in the chapter entitled "Coal Tar Colors," would not the material concerning young William Henry Perkin and his work entice students to read further?

During recitations, questions are asked of the teacher. Someone at one of our previous meetings well said "The diplomatic thing to do is to give the answer, but the pedagogical thing is to tell him where to find the answer." In answer to many of these questions, the student can be directed to a book in the library.

OF COURSE, if one wants to be sure the students are really making use of the library, there is the method of requiring it. If this is done, the material offered for reading, above all things, should be interesting to the student. A method found successful and enjoyable to the students, makes use of long list of references, dealing with the unit being studied. Challenging questions pertaining to the reading are given with each reference. The list should be long enough to make sure an appeal is made to each student. This list may be given a few days after the class has started a study of the unit. The answers to a certain

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PROJECTS IN CONSUMER CHEMISTRY

(Continued from page 21)

Book of Formulas, Consumer Union reports and Consumer Guide.)

7. The preparing of cold cream and vanishing cream. (Preparation according to formulas obtained from Henley's Book of Formulas, Consumer Union reports.)

Testing Soap for Alkali

1. For Free Alkali:

Dissolve one gram of the soap to be tested (reduced to fine shavings) in alcohol free from acid, (warming on a water bath at 65° C. will assist putting the soap into solution) filter and rinse thoroughly with alcohol. Test the filtrate for alkali using five drops of phenolphalein as an indicator. Intensity of color with given amount of indicator is a basis for comparing amount of free alkali in various soaps.

Note: All materials in the soap except the filler are soluble in alcohol. The residue on filter is the filler. Make note of the amount and appearance of it. If the amount of filler is wanted, it can be weighed after drying at 100° C.

2. For Alkali in Filler:

Wash the residue on the filter paper in part 1, several times with warm water and collect in a clean test tube. Dilute to 10 c.c. and add five drops of methyl-orange indicator. The intensity of the yellow color is a basis for comparing alkali due to filler.

Note: The amount of free alkali and alkali due to filler can be determined by titration of above solutions with 1N-H_2SO_4 using indicators mentioned.

References:

Brannt, Soap Makers Handbooks, page 489.
School Science and Mathematics, page 545, June 1939.

Abrasives and Soap in Dentrifices

1. For Abrasives:

Place a small amount of the dentifrice to be tested on a clean unscratched glass plate. Place a five cent piece on top of it and then with the forefinger upon the coin move back and forth with light pressure. Continue for a minute and then wash and dry the glass plate. Harmful abrasive is indicated by scratch lines in the glass.

Note: Secure some precipitated chalk in the laboratory and repeat and compare results.

2. For Soap:

Mix 2 cc. of the tooth paste or powder with 5 cc. of alcohol, warm and stir. Let stand for 5 minutes, then filter. Collect filtrate in clean test tube. Evaporate over a steam bath on a clean watch glass. Relative amounts of soap in various powders may be compared with each other and relative amounts of soap in tooth pastes tested can be compared with each other. In order to compare soap in pastes with soap in powders, the pastes should be dried at 100° C. before measuring for the test.

Note: A dentifrice should be an aid to the brush in cleaning the teeth; should contain no harmful abrasive, little or no soap, and no harmful chemicals; and should also be inexpensive.

References:

School Science and Mathematics, June 1939.
Consumer Guide, Department of Agriculture.
Consumers Union Annual Reports, 1938-39.
Bennett: Chemical Formulay, Vol. I, pp. 388-389.

TEACHER AND HIS JOURNAL

(Continued from page 5)

who wants to read more extensively than the textbook requires.

WITH absorbing interest the writer has observed the growth and development of dozens of science teachers, first as they progressed in college and later as they grew in their profession. He is convinced that their development is determined not so much by what the college does to them as by what they do for themselves. A most important agency in this growth is a good science teacher's journal. Subscribe to your journal and read it regularly. Let the current numbers have a place on the desk.

JUNIOR ACADEMY

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much more than is possible in the regular science class. Also that the science club is the one club which may function 12 months in the year as the members may work individually during the summer as well as with the group during the school year; that the science club does meet the interests of the adolescent as it makes it possible for him to see things happen and to have adventure.

District meetings, because of the size of Kentucky, are very much needed. The attendance and the exhibits at the annual meeting are already beginning to tax the facilities of the high schools and yet many high schools are not represented. District meetings will make possible the participation of all high schools, and the annual meeting will then be attended by the officers and the delegates of the respective affiliated clubs, and only exhibits rating Superior and Excellent at the district meetings will be displayed. The Junior Academy hopes to hold district meetings in 1942 in addition to the annual meeting which will be the tenth anniversary.

THE PRINCIPAL activities of the Kentucky Junior Academy are:

1. Issuing the Junior Science Bulletin which is the official publication varying from six to eight pages and appearing regularly for and by the junior members.

2. Holding the annual meeting at which time the work of the year is displayed. Discussions by members are given and announcement of the ten awards is made.

3. Exchanging meetings by the affiliated clubs and making special financial contributions in addition to paying the regular dues.

4. Sponsoring science study during the summer vacation.

5. Encouraging work in Conservation and in Safety.

SLIDES AND FILM STRIPS

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In order to fill the negative area when photographing small diagrams or photographs it is necessary to bring the camera close to the copy. Although supplementary lenses will make this possible, they will adversely affect the sharpness of the image. This writer has obtained excellent results using a Perfex 55 camera with a Wollensak :3.5 lens and a 11/32 inch extension tube.

The use of the extension tube for close up work produced critically sharp negatives. With the focusing scale set at infinity, the copy area of 5"x 7" will fill the negative area when the copy is placed 42.5 cm. from the back of the camera.

The writer has found the SVE Tri-Purpose projector very suitable for projection, as it will accept lantern slides (2"x 2"), single, or double frame film strips.

THE FINISHED transparencies may be used in strip form, or cut and mounted between the 2"x 2" cover glasses with a framing mat.

Positive film is particularly suited for copying work. If, however, it is desired to make transparencies of actual scenes it is advisable to use the new reversible panchromatic film marketed by Agfa and Eastman-Kodak. Full instructions accompany these films. Kodachrome can be used when color reproductions are wanted.

Time Table for the Reversal of Positive Film

(Keep all solutions and wash water at 65 degrees F. and agitate about 30 seconds every two minutes.

1. Develop in F1 for 16 minutes.
2. Wash for ten minutes.
3. Bleach for 6 minutes in F2 (or until image is bleached out).
4. Wash for 5 minutes.
5. Clear in F3 for 6 minutes.
6. Wash for one minute.
7. Remove film from reel and expose to electric lighting in room for about 1 second.
8. Develop in F4 until desired density is reached. If greater density is desired re-expose the film for another second or two and continue to develop. The usual time of development will be 2 to 4 minutes.
9. Rinse in water. Fix in F5 for about 5 minutes.
10. Wash for about 10 minutes and hang up to dry.

Formulas

F1 — Use equal volumes of Agfa 103 or E.K. D72 (stock) developer and a solution of 18 grams of sodium hydroxide in 1 liter of water.

F2 — 8 grams of potassium bichromate and 8 cc. of concentrated sulphuric acid in 1 liter of water (add acid to water).

F3 — 50 grams of sodium sulphite in 1 liter of water.

F4 — D72 diluted 1:3 of water or Agfa 103 diluted 1:3.

F5 — Any standard fixer-hardener.

Formulas F2, F3, and F5 may be used for several rolls of film. F1 and F4 should be used only one time.

SCIENTIST AND CONSUMER

(Continued from page 28)

that every established brand carries its owner's reputation, the question remains: Reputation for what? Only the rare manufacturer of priceless precision instruments or expensive oddities is trying to make the very best product that can be made. Many of them are making a reasonably best grade of product, and many are deliberately making products not up to the best but good at a price. This is good sense; it corresponds to the demands of consumers. Practically no consumers can buy the absolutely best; relatively few can afford the reasonably best; most must be satisfied with the best they can get at the price paid. But how to get it? Good faith and reputation stamped on the label mean little unless the consumer knows what specific quality the reputation is meant to stand for. Most names and labels do not disclose this all-important fact."

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USE OF LIBRARY

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number of these questions are to be written and handed in. In using this method for the first time during the year, a period or two of supervision will be a great help in getting them started, and in the long run, will pay dividends. The fact that a student learns answers to specific questions is by no means the important virtue in this method. The student will first read carefully all questions to see which appeal to him most. It is the fact that these questions beckon the student to the book or magazine that makes the method successful. The student will gain much more knowledge than the answers to these questions.

In introducing the class to a set of required readings concerning a unit, another method can be followed. With each reference is included a brief description of it. The student can read them all and decide what references has the most meaning to him. Here again, the list should appeal to as large a variety of interests as possible. The student may be asked to write a summary of each required reading. He may also be asked to give his reaction to it by writing a brief report on the relation it has to public health, national defense, our economic welfare, or other such topics.

THIS METHOD of required reading can become a source of wholesome enjoyment to the class. If the teacher is deeply interested and enthusiastic, if many interests are appealed to, if time is allowed for it, and if the reporting is not burdensome, students will show that the outcomes are most tangible.

Thomas Carlyle has said, "All that mankind has done, thought, gained, or been, is lying as in magic preservation in the pages of books."

Should not we science teachers guiding these boys and girls, who come our way but once, show them this rich heritage which is rightfully theirs?

EVALUATION OF METHODS

(Continued from page 19)

mann-Anderson test of mental ability were compared with the progress made by both Group I and Group II as determined by the scores of the Cooperative Test it was found that there was less divergence. In general the student with the higher I. Q. made more progress than the one with the lower I. Q. irrespective of which group he was in.

(3) In a comparison between Group I and Group II of the scores made on the Cooperative Test alone it was found that Group II averaged as a whole four points higher than Group I as a whole.

(4) No numerical comparison could be made between the write-ups and reports made by the groups on the field trips and excursions they had taken. It seemed that the students in Group II were better able to express themselves in a group, worked with others more harmoniously, assumed more responsibility in their work, and were more capable of directing their own activities than those in group I. It is certain that of the papers handed in, those of the socialized group showed a greater appreciation of biological principles and better organization than those of the nonsocialized group.

Conclusions

(1) The fundamental skills of reading and writing are necessary before the student can participate to any degree in any learning situation.

(2) Different individuals learn best by different activities. It was found that in some cases the students would modify the study guides made by the investigator and oftimes completely constructed their own while others followed the original study guides implicitly. Greater divergence occurred as the work progressed. Therefore, it would seem to be desirable to employ a variety of methods and presentations over any one plan of organization and procedure.

(3) A course of study organized around the "big ideas" or generalizations of biology is definitely superior in helping the student solve new problems, in creating appreciations, in developing attitudes and skills, and even in the retention of factual information than is the one organized around the acquisition of a mass of isolated facts.

(4) Attitudes can be developed and are developed more definitely when the teacher makes a conscious effort in that direction. Scientific attitudes and scientific thinking are not necessarily acquired by studying science. There must be a conscious effort in that direction.

EXPLOSIVES

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Powder Companies celebrated their twenty-fifth anniversaries last year. The Hercules Powder Company in its anniversary booklet, called "Looking Ahead," states that the original markets in mining, quarrying and construction are relatively the same today as they were twenty-five years ago. The annual poundage of explosives produced has remained practically constant, although these industries have increased space with the general expansion of the last quarter century. This situation exists in fact only because modern explosives have been so improved that they do more work per pound than the older ones. The major powder companies have, however, undergone tremendous growth since 1913, which can be attributed to diversification of the products manufactured with corresponding expansions in their markets.

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INSTRUCTION IN CHEMISTRY

(Continued from page 9)

per, which usually occur with silver. This, of course, has far reaching effects.

I wish, too, that we might emphasize somewhat more the philosophical aspects of chemistry. The study of atomic structure and of the periodic table offers wonderful opportunity to point out the unity of nature which underlies its apparent complexity. I believe that lessons of this sort, if effectively taught, will remain with the student and influence his thinking long after he has forgotten how to prepare sulfuric acid and how to separate copper from cadmium.

FINALLY, the teaching of the language of chemistry deserves more emphasis from most teachers. I have heard it said that a student in a beginning course learns more new words than a student taking a beginning course in a foreign language. This, on top of the burden of learning a great deal of descriptive material and some of the theories of chemistry, is a terrific load. Yet it seems imperative, for we cannot think or express ourselves on chemical subjects without the accurate use of chemical terms. Careless and incorrect expression is usually a sign of careless thinking. If one of our objectives is to teach scientific thinking, we may well begin by insisting on clear, concise expression.

The problem of improving instruction in high school chemistry might be summed up by saying that the present course attempts to cover too much material. Further, I believe that much of the strictly technical material could well be eliminated, and part of it replaced by instruction in clear thinking and in discussion of what chemistry is doing to our modern world.

MEDICAL PRACTICES

(Continued from page 16)

and the ignorance of superstition has long been waging and is not over.

World Book, Vol. 11, P. 6934

An investigation of superstitious practices familiar to the boys and girls in my school.

BOOK SHELF

Between the Planets. Fletcher G. Watson, Harvard College Observatory. The Blakiston Company, Philadelphia, Pa., 1941. 222 pages, 106 illustrations. $2.50 list.

The author ably sets forth the latest discoveries about the comets, meteors, asteroids and meteorites. The popular style is appealing to the young learner and the layman with a curiosity about the heavens. Among the many illustrations are some photographs of a high degree of excellency. Numerous tables supplement and extend the wealth of factual material presented.

Among the topics discussed are: the past history of comets; the crystalline structure of meteorites; the motions and number of asteroids; meteor showers; and the formation of meteor craters.

The book is particularly well bound. The slight gloss of the paper stock may at times be somewhat annoying to the reader, but it enhances the effectiveness of the illustrations.

Working with the Microscope. Julian D. Corrington, Ph.D., Professor of Biology, Washington College, Chestertown, Maryland. McGraw-Hill Book Company, Inc., New York, 1941. 418 pages, 121 pictures and diagrams. $3.50, list.

For those who are learning to use the microscope correctly as well as to prepare their own mounts for examination, "Working with the Microscope" will be found very helpful. It covers all phases of the work very completely. It is not designed, however, for the advanced professional worker in this field.

Practically every type of subject is carefully treated. These range from microfossils and pond life to photomicrography, sections, and textiles. By following the simple directions an amateur starting from scratch, as well as those of more experience, may train himself in the correct technique for using the microscope. It is written in the form of a series of graded lessons that gradually lead into the more difficult phases of the work.

Not only does the book help in learning procedures, but it helps in encouraging and directing the amateur to the study of the more interesting forms of life. Thus it is particularly valuable, not only to the individual working on his own initiative, but also to clubs and groups that make microscopy a hobby. The book also appears to be suited to use in the junior college or teachers college.

The section dealing with the preparation and use of reagents is especially useful, even to the advance worker. The more useful modern chemicals are included.

FUNCTIONAL BIOLOGY COURSE

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AND, FINALLY, I would urge that you recognize the contribution which you have to make to the development of citizenship. We hear much nowadays about citizenship training and character building. We are constantly being reminded of the failures of public and private education to make our youth conscious of civic responsibility, to make them conscious of the demands which our society makes upon them as individuals with a contribution which they have and must give to society. Citizenship is more than exercise of one's franchise or of observing the laws on the statute books or of understanding of how the state comes into being, exists and perpetuates itself. It is more than a matter of the study of various phases of government, legislative, executive, and judicial. As a teacher of the biological sciences, you have no less responsibility for stimulating youth to live properly in a democracy than has the teacher of any subject. In fact, you stand in a unique position to stimulate ideals of citizenship and you are remiss in your responsibility if you fail to discover the many ways in which biology contributes or may contribute to the making of better citizens, citizens who appreciate nature in all of its many ramifications.